

A REVISION OF THE GENUS *MESTOCHARIS* AND A REVIEW  
OF THE GENUS *GRAHAMIA* (HYMENOPTERA, EULOPHIDAE)

CHRISTER HANSSON

Department of Systematic Zoology, Lund University, Helgonavägen 3, S-223 62 Lund, Sweden.

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*Abstract.*—The Nearctic and Palearctic species of the genus *Mestocharis* Förster are revised. Three species are recognized, one exclusively Nearctic (*M. tropicalis*), one exclusively Palearctic (*M. maculata*) and one found in both regions (*M. bimacularis*). *Mestocharis nearctica* Yoshimoto is a new junior synonym of *M. bimacularis*. Hosts are known only for *M. bimacularis*, a gregarious endoparasitoid in eggs of larger Dytiscidae (Coleoptera). The two known species of *Grahamia* are reviewed and characters are presented to facilitate their separation. Both species are recorded as new to the Nearctic Region. The biology is known only for *G. clinius*, a parthenogenetic endoparasite of *Haplodiplosis equestris* (Diptera, Cecidomyiidae) in Europe.

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*Mestocharis* has been treated in two rather recent papers, one dealing with the European (Bouček et al. 1963) and the other with the North American species (Yoshimoto 1976). Bouček et al. recognized two species (*M. bimacularis* (Dalman) and *M. maculata* (Förster)) and established two new combinations and three new synonyms. They dealt also with the intraspecific variation of taxonomically important characters and presented a key. Yoshimoto described two new species (*M. nearctica* and *M. tropicalis*), compared them to the European species, and presented a key to the Nearctic species. The material I have at my disposal indicates that the intraspecific variation described in those papers was underestimated. The consequences of this underestimation are that some characters used for separating the species are unsafe and that one of the species is invalid. The biology is known only for *M. bimacularis* (Jackson 1958, 1960, 1964), an endoparasite in eggs of larger Dytiscidae (Coleoptera). Two other

Nearctic species were described as *Mestocharis* (*M. wilderi* Howard, *M. williamsoni* Girault), but both have been transferred to *Pediobius* Walker (Burks 1958: 68-69).

The genus *Grahamia* was erected to include *Entedon clinius* Walker and *Grahamia tatica* Erdös (Erdös 1966). Later, Bouček and Askew (1968) catalogued the Palearctic Eulophidae and added new distribution records and corrected some previous host records for the genus. Hansson (1985) speculated that the two species might be the same because of high intraspecific variation in the length of flagellar segments, the only character separating the two species, but made no definite decision regarding the validity of the two species. Because I have had access to a fairly large sample of these species from Europe and from North America, I conclude that the two species are valid. A key is presented to facilitate their identification. The host is known only for *G. clinius*, a parthenogenetic endoparasite of *Haplodiplosis equestris* (Diptera, Cecidomyiidae) in Europe.

Morphological terms used are explained

in Hansson (1985), the exception being POO, the distance between posterior edge of hind ocelli and occipital margin. Abbreviations of museums and private collections used in the text were as follows: BMNH = British Museum (Natural History), London, England; CH = collection of the author; CNC = Canadian National Collections, Ottawa, Canada; DAFZ = Department of Agriculture and Forest Zoology, Helsinki, Finland; INHS = Illinois Natural History Survey, Champaign, Illinois, USA; HNHM = Hungarian Natural History Museum, Budapest, Hungary; LUZM = Lund University Zoological Museum, Lund, Sweden; SMNH = Swedish Museum of Natural History, Stockholm, Sweden; USNM = National Museum of Natural History, Washington, D.C., USA.

**Genus *Mestocharis* Förster**

*Mestocharis* Förster, 1878: 50. Type-species: *Entedon bimacularis* Dalman, 1820: 181 (= *Mestocharis cyclospila* Förster, 1878: 50), by original designation.

Diagnosis.—Species of *Mestocharis* are distinguished from other genera of Entedontinae by the following combination of characters: both sexes with two small and discoid anelli; antennal scrobes adjoining on horizontal line of frontal fork; mandibles tridentate; transverse pronotal carina absent; postmarginal vein about as long as stigmal vein; anterior part of propodeum with two conspicuous indentations laterally; anteromedian part of propodeum with a large and more or less triangular projection.

Remarks.—The monophyly of *Mestocharis* is shown through the following synapomorphies: 1) anterior part of propodeum with two conspicuous indentations laterally; 2) anteromedian part of propodeum with a large triangular projection.

**KEY TO THE HOLARCTIC SPECIES OF *MESTOCHARIS***

- 1. Females . . . . . 2
- Males (that of *M. tropicalis* is unknown) . . . . . 4

- 2. Costal cell with a complete row of setae on underside; 2nd tergite smooth and shiny . . . . . *M. maculata* (Förster)
- Costal cell bare; 2nd tergite microreticulate (Fig. 1) . . . . . 3
- 3. Seventh tergite 1.2–2.0 × as long as width of base of same tergite (Fig. 8); scutellum smooth and shiny medially along its entire length . . . . . *M. tropicalis* Yoshimoto
- Seventh tergite 0.4–1.0 × as long as width of base; scutellum with weaker reticulation medially, but not smooth (Figs. 1, 6) . . . . . *M. bimacularis* (Dalman)
- 4. Costal cell with a row of setae on underside, antenna mainly testaceous . . . . . *M. maculata* (Förster)
- Costal cell bare, apical part of scape and the antenna beyond usually infusate . . . . . *M. bimacularis* (Dalman)

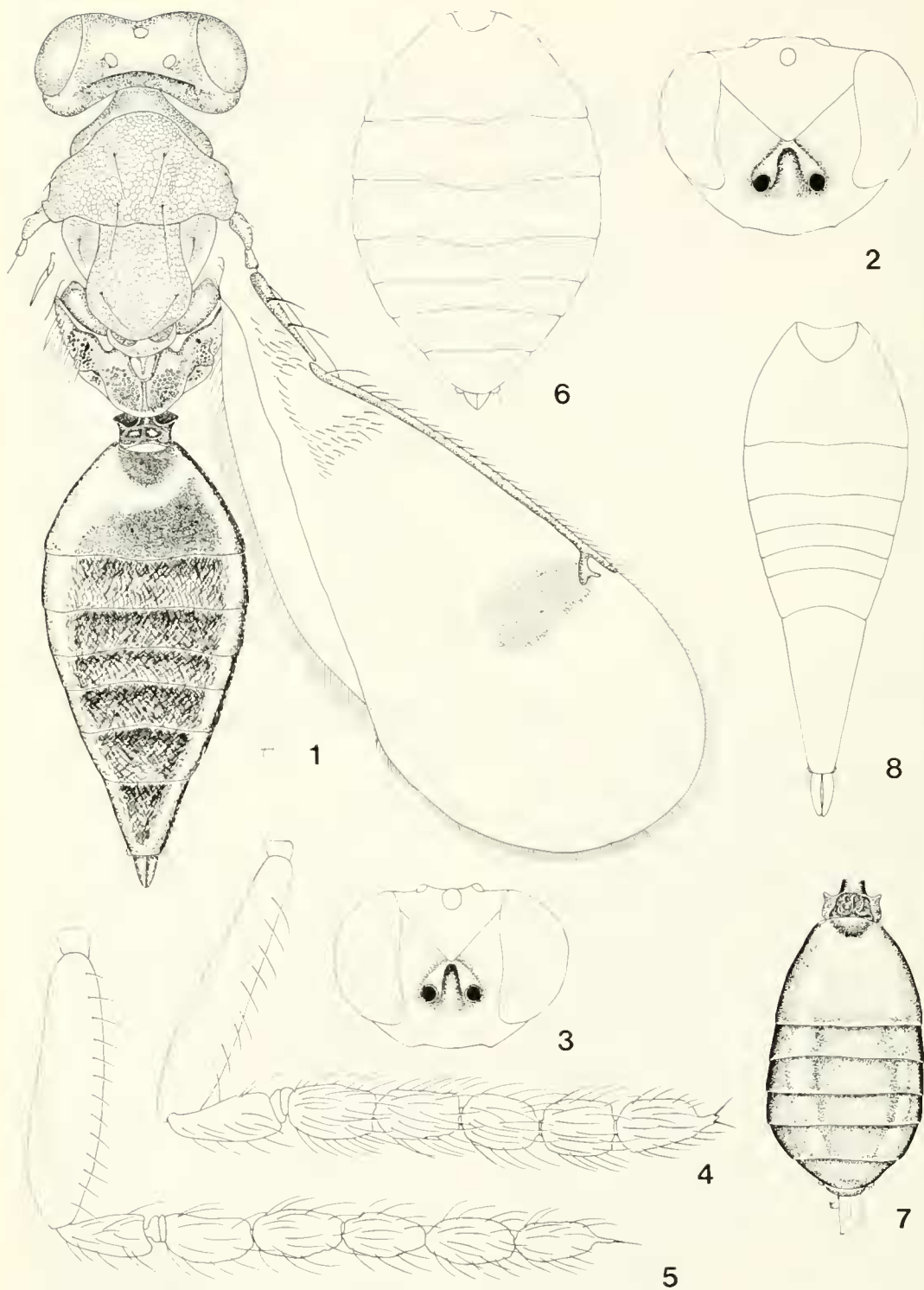
***Mestocharis bimacularis* (Dalman)**

Figs. 1–7

- Entedon bimacularis* Dalman, 1820: 181.
- Entedon arisba* Walker, 1839: 121–122. Syn. Bouček et al., 1963: 5.
- Mestocharis cyclospila* Förster, 1878: 50. Syn. Bouček et al., 1963: 5.
- Mestocharis militaris* Rimsky-Korsakov, 1933: 232, 244–245. Syn. Bouček et al., 1963: 5.
- Mestocharis nearctica* Yoshimoto, 1976: 756–757. New synonymy.
- Mestocharis bimacularis* (Dalman), Bouček et al., 1963: 5.

Diagnosis.—Costal cell bare; second tergite microreticulate; seventh tergite 0.4 to 1.0 × as long as wide at base; scutellum reticulate all over; femora usually more or less infusate.

Description.—*Female*: Entire antenna dark, except scape more or less pale at base. Face and clypeus golden-green, frons completely golden-purple or golden-green below frontal fork. Vertex, mesoscutum and scutellum golden, coppery, golden-green or golden-red. Coxae dark and metallic, major part of femora dark and more or less metallic, tibiae varying from brownish to yellow, base of tibiae occasionally dark, foretarsi dark, mid- and hindtarsi with basal



Figs. 1-8. *Mestocharis* spp. 1-7, *M. bimacularis*. 1. Habitus, female. 2. Front view of head, female. 3. Same, male. 4. Female antenna. 5. Male antenna. 6. Female gaster. 7. Male petiolus and gaster. 8. *M. tropicalis*, female gaster.

three segments pale and with 4th segment dark. Forewing with a large fuscous spot just below stigmal vein, usually also with two much fainter spots below that spot (see remarks for comments on these spots). Propodeum and gaster golden-green. Length of body: 1.6–2.6 mm. Ratios height of eye/malar space/width of mouth opening = 3.1/1.0/2.0. Malar space 2.5–3.0× as wide as width of scape. Frons below fork with very weak reticulation and almost smooth, part between toruli and antennal scrobes raised in a conspicuous, blunt elevation. Frons above fork smooth and shiny in lower part, in upper part reticulate with low and narrow septa, and with small meshes. Horizontal line of frontal fork shaped like a V. Inner orbit of compound eye with 1 to 2 rows of setae. Vertex reticulate with very low and very narrow septa inside ocellar triangle, outside smooth and shiny. Ratios POL/OOL/POO = 6.0/3.1/1.0. Occipital margin with a ±strong carina behind ocellar triangle. Ratio width of head/width of thorax across shoulders = 1.1. Mesoscutum and scutellum reticulate with high and wide septa, median part of scutellum with lower septa. Forewing with speculum closed, base of submarginal vein with a short row of setae on underside. Propodeum with a strong and complete median carina, plicae complete or missing in anterior part of propodeum, propodeal surface rather strongly reticulate, also with irregular carinae. Propodeal callus with 6–9 and lateral part of propodeum inside spiracular sulcus with 3–10 setae. Petiolar foramen rounded. Petiolus transverse, median part with considerably raised carinae, lateral corners protruding and sharp. Shape of gaster varying from ovate (Fig. 6) to lanceolate (Fig. 1). First tergite smooth and shiny, tergites 2–5 microreticulate in anterior 3/4, tergites 6–7 with stronger reticulation. Mean ratio length of thorax + propodeum/length of gaster =  $0.82 \pm 0.104$ ,  $n = 10$ .

*Male*: Scape pale with apical part dark, pedicel and two first flagellar segments oc-

asionally paler than remaining flagellum, which is dark. Face and frons golden-green or -blue, vertex golden-red. Thorax golden-green, -blue or -red. Coxae dark, remainder of legs yellowish, hindfemur usually dark at base. Forewing immaculate. Metallic coloration much brighter than in female. Length of body: 1.3–1.8 mm. Frons above fork and vertex smooth and shiny. Ratios height of eye/malar space/width of mouth opening = 4.6/1.0/2.6. Malar space as wide as width of scape. Ratio width of head/width of thorax across shoulders = 1.3. Propodeal callus with 4–7 and lateral part of propodeum inside spiracular sulcus with 2–7 setae. Petiolus like in female, but varying in shape from transverse to as long as wide. Mean ratio length of thorax + propodeum/length of gaster =  $1.06 \pm 0.087$   $n = 10$ .

Remarks.—The dark spots on the female forewings are apparently characters that develop with age. Newly emerged females have immaculate forewings, while the same females 8–13 days later have clearly visible spots. In females that have lived 9–10 months the spots are exceptionally dark (Jackson 1964).

The shape of the female gaster is variable in this species, varying from ovate (Fig. 6) to lanceolate (Fig. 1). This character (actually, the shape of last tergite) was used in Bouček et al. (1963) to separate *bimacularis* from *maculata*: the last tergite was about half as long as its basal width in *bimacularis* and as long or longer as its basal width in *maculata*. In Swedish specimens of *bimacularis* last tergite varies from slightly less than half as long to as long as its basal width.

Yoshimoto (1976) separated *nearctica* from *bimacularis* through several characters presented in a table. However, these characters are either so variable intraspecifically that they have no taxonomic value or are misinterpreted. The propodeal carinae are variable characters. The median carina is usually strong, wide and complete, but in a few specimens it is narrower. The diagonal carina extending from the triangular pro-



jection to the sides of the petiolar foramen varies from strong and complete to completely missing. The hind margin of the first tergite is usually sinuate while the hind margin of the second tergite varies from almost straight to sinuate. The characters of the male antenna of *nearctica* must have been misinterpreted by Yoshimoto. A male paratype of *nearctica* (Can., Ont., Ottawa 19.vii.1939, O. Peck) that I saw showed the following characters: the scape is yellow with apical fourth infuscate and the first flagellar segment is about  $1.8\times$  as long as wide. The measurements of the fifth flagellar segment are correct ( $1.7\times$  as long as wide), but this is also about the same size usually encountered in *bimacularis*. Consequently I regard *nearctica* as a synonym of *bimacularis*.

Material examined.—Two paratypes of *M. nearctica* (1 ♀ and 1 ♂, in CNC); Canada: British Columbia 2 ♀ (CNC, LUZM); Newfoundland 1 ♂ (BMNH); Nova Scotia 1 ♀ (CH); Ontario 1 ♀ (LUZM). Finland: 3 ♂ (DAFZ). Sweden: 40 ♀ 24 ♂ (CH, LUZM). USA: Michigan 1 ♂ (USNM). Lectotype ♀ *E. bimacularis* (not seen) in SMNH.

Hosts.—This species is a solitary or gregarious endoparasitoid in eggs of Dytiscidae (Coleoptera). The size of the egg restricts the number of wasps that can develop successfully, in larger eggs, e.g. those of *Dytiscus marginalis*, up to 12 wasps have been reared, while in smaller eggs, e.g. those of *Ilybius ater*, only one wasp developed (Jackson 1964). Imagines of *M. bimacularis* are most frequently encountered in pond- or marsh vegetation.

Distribution.—Widespread in Europe (Bouček and Askew 1968), in the Nearctic Region this species is recorded from both Canada (Alberta, Manitoba, Ontario and Quebec (Yoshimoto 1976); British Columbia, Newfoundland and Nova Scotia) and the United States (Michigan).

#### *Mestocharis maculata* (Förster)

*Eulophus maculatus* Förster, 1841: 41–42.  
*Pleurotropis maculata* (Förster), Erdős, 1956: 38–39.

*Mestocharis maculata* (Förster), Bouček et al., 1963: 9.

Diagnosis.—Costal cell with a complete row of setae on underside; second tergite smooth and shiny; femora more or less pale testaceous. In other characters *M. maculata* is very similar to *M. bimacularis*, and the description of *bimacularis* is otherwise applicable to *maculata*.

Material examined.—USSR: Moldavian SSR 1 ♂; Yugoslavia: Beograd 1 ♀. Both specimens are from the Bouček collection. Lectotype ♀ *E. maculatus* (not seen) in the Förster collection in Vienna.

Distribution.—Europe: Czechoslovakia, Germany, Hungary and USSR (Bouček and Askew 1968).

#### *Mestocharis tropicalis* Yoshimoto

Fig. 8

*Mestocharis tropicalis* Yoshimoto, 1976: 757.

Diagnosis.—Seventh tergite  $1.2$  to  $2.0\times$  as long as width of base of same tergite; scutellum smooth and shiny medially along its entire length; costal cell bare; femora pale. Males are unknown for this species.

Remarks.—This species is similar to its two congeners but can be separated from them using the characters given in the key. The 7th tergite shows a great deal of intra-specific variation. I have seen only two specimens, both females, one from Florida (paratype) and one from Illinois. The specimen from Florida had ratio length/basal width of 7th tergite =  $1.2$ , and the specimen from Illinois =  $2.0$ . There is a great gap between these two measurements, but when more material turns up this gap may be filled. The shape of the gaster is more lanceolate than in *M. bimacularis*, which leaves no doubt that *tropicalis* is a valid species. Like *M. bimacularis*, *tropicalis* also has a fuscous spot just below the stigmal vein, but not the two fainter spots present in *bimacularis*.

Material examined.—Paratype ♀ (CNC); 1 ♀ from USA, Illinois, Champaign Co. (INHS). Holotype ♀ (not seen) in CNC.

Distribution.—The United States (Florida, Illinois).

**Genus *Grahamia* Erdős**

*Grahamia* Erdős, 1966: 406. Type-species: *Entedon clinius* Walker, 1839: 90, by original designation.

Diagnosis.—Species of *Grahamia* are distinguished from other genera of Entedoninae by the following combination of characters: all flagellar segments free; antenna with only one small and discoid anellus; mandibles tridentate; pronotal collar without transverse carina; costal cell narrow; postmarginal vein about 2× as long as stigmal vein.

Remarks.—The monophyly of *Grahamia* is shown through the single discoid anellus, a synapomorphy for the genus. Two things might argue against the value of this character. First, it is clearly a reduction (the plesiomorphic character state is three anelli, present in the closely related genus *Chrysocharis* Förster). Reductions are sometimes regarded as poor apomorphic character states. Secondly, this character state (one discoid anellus) occurs in other closely related genera (some *Chrysonotomyia* Ashmead and *Closterocerus* Westwood). Nevertheless, I prefer to keep *Grahamia* a separate genus from *Chrysocharis*, the genus to which *Grahamia* shows closest morphological affinity. Among the species-groups of *Chrysocharis* (sensu Hansson 1985), *Grahamia* comes closest to the *mediana*-group. *Grahamia* has, however, some characters that disagree with this assessment: its single discoid anellus of the antenna, all flagellar segments free, and gallmidges as hosts. *Chrysocharis* has three anelli, two apical flagellar segments fused in species of the *mediana*-group, and leafminers as hosts.

KEY TO THE SPECIES OF  
*GRAHAMIA* (FEMALES)

- 1. First segment of flagellum about 2× and 4th segment about 1.5× as long as wide (Fig. 12); malar space about 1.5× as wide as width of scape; metallic coloration of body comparatively dull ..... *G. clinius* (Walker)

- First segment of flagellum about 1.5× and 4th segment 1× as long as wide (Fig. 10); malar space narrower (as wide as width of scape); metallic coloration of body brighter ..... *G. tatrica* Erdős

***Grahamia clinius* (Walker)**

Figs. 11–12

*Entedon clinius* Walker, 1839: 90.

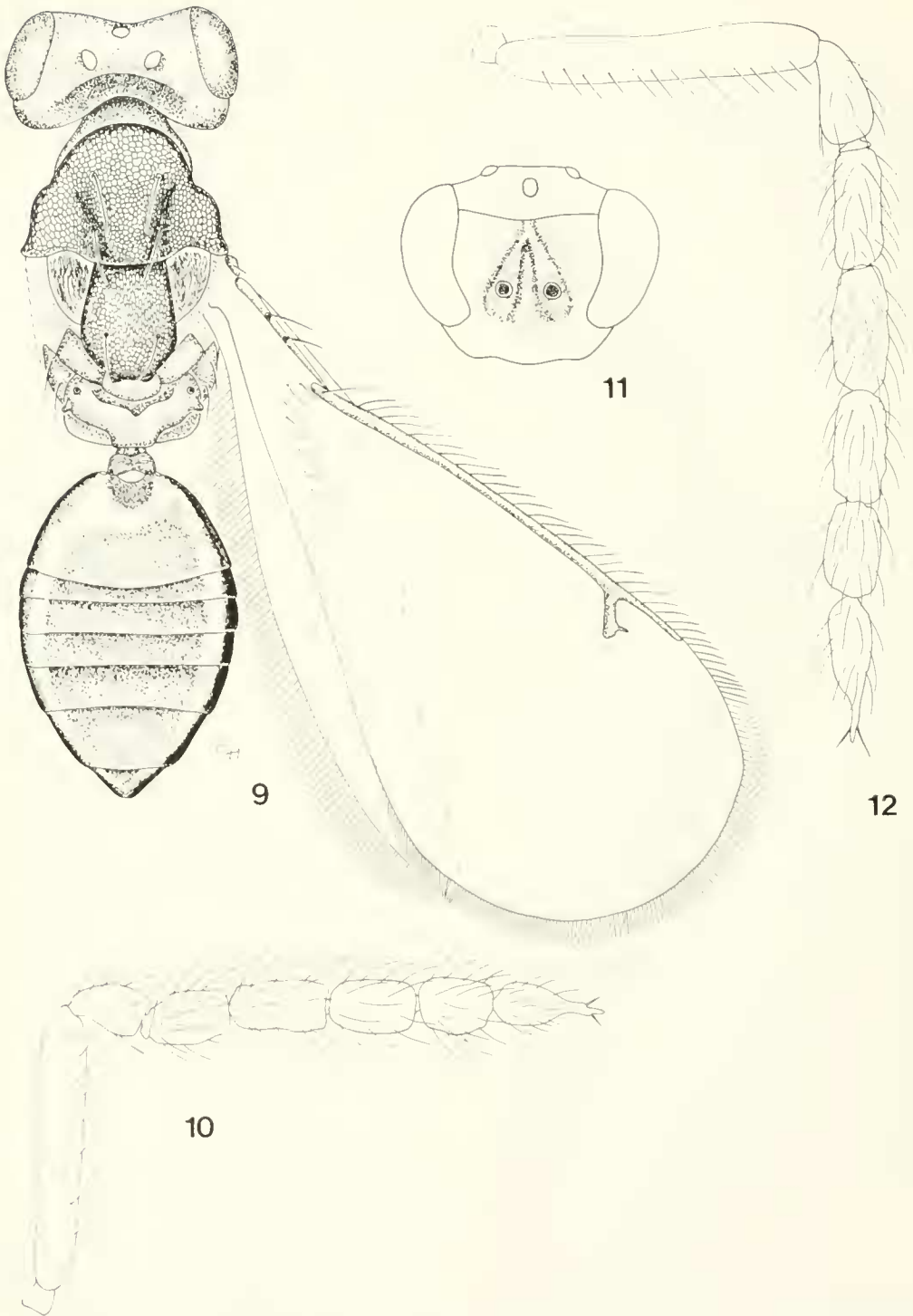
*Chrysocharis clinius* (Walker), Graham, 1959: 196.

"*Chrysocharis*" *clininius* (Walker), Graham, 1963: 204.

*Grahamia clinius* (Walker), Erdős, 1966: 407.

Diagnosis.—Flagellar segment 1 about 2× and 4 about 1.5× as long as wide; malar space 1.5× as wide as width of scape; metallic coloration of body dull; larger species (1.6–2.1 mm).

Description.—*Female*: Entire antenna dark, scape occasionally paler in basal half. Face and clypeus golden-green. Frons and vertex metallic purple, below fork sometimes golden-purple. Mesoscutum golden-green and scutellum metallic purple. Coxae dark brown and weakly metallic. Femora predominantly dark, fore- and midtibiae varying from pale to infusate, hindtibia predominantly pale, tarsi ± infusate, 4th segment dark. Wings hyaline or weakly infusate. Propodeum and gaster golden-green. Length of body: 1.6–2.1 mm. Ratios height of eye/malar space/width of mouth opening = 3.9/1.0/2.8. Malar space 1.5× as wide as width of scape. Frons below fork reticulate with low and rather narrow septa, meshes small, above fork shiny and almost smooth. Horizontal line of frontal fork almost straight. Inner orbit of compound eye with one row of setae. Vertex reticulate with very low and very narrow septa. Ratios POL/OOL/POO = 3.3/2.2/1.0. Occipital margin with a carina behind ocellar triangle. Ratio width of head/width of thorax across shoulders = 1.3. Mesoscutum reticulate with low and rather narrow septa, meshes small. Scutellum reticulate with low to very low and narrow to very narrow septa, i.e. with finer



Figs. 9-12. 9-10, *Grahama tatarica*, female. 9, Habitus. 10, Antenna. 11-12, *G. clinius*, female. 11, Front view of head. 12, Antenna.

reticulation than mesoscutum. Anteromedian part of propodeum with a weak triangular fovea, propodeal surface  $\pm$ reticulate, with or without a weak median carina. Propodeal callus with two setae. Petiolar foramen rounded. Petiolus small and transverse. Gaster elongate, ratio length of thorax + propodeum/length of gaster = 0.67–0.87.

Remarks.—The species *Tetrastichus idothea* Walker, 1844: 409, was regarded as a possible synonym of *G. clinius* by Graham (1961: 62).

Material examined.—Lectotype *E. clinius* ♀ (BMNH Type No. 5.2025); BRD: 1 ♀ ex *Hapl. equestris* (USNM). Canada: British Columbia 3 ♀ (CNC, LUZM). Sweden: 1 ♀ (CH).

Host.—*Grahamia clinius* is known as an endoparasitoid in larvae of *Haplodiplosis equestris* (Diptera, Cecidomyiidae) (Baier, 1963/64, as *Chrysocharis seiuncta*). The sex ratio of reared *G. clinius* (♀:♂ = 100:1) (Baier 1963/64) suggests that the species propagates parthenogenetically.

Distribution.—*Grahamia clinius* is widespread in Europe (Bouček and Askew 1968), and now for the first time recorded from the Nearctic Region (Canada, British Columbia).

### *Grahamia tatrlica* Erdős

Figs. 9–10

*Grahamia tatrlica* Erdős, 1966: 407.

*Chrysocharis atripes* Szelenyi, 1979: 178.  
Syn. Hansson, 1985: 97.

Diagnosis.—Flagellar segment 1 about  $1.5 \times$  and 4 about  $1 \times$  as long as wide; malar space as wide as width of scape; metallic coloration of body brighter; smaller species (1.3–1.5 mm).

Remarks.—Apart from the distinguishing characters *G. tatrlica* is very similar to *G. clinius* and the description of *clinius* is applicable to *tatrlica*.

Material examined.—Paratypes 2 ♀ *G. tatrlica* (HNHM Nos. 6061 & 6062); Canada: Nova Scotia 1 ♀ (LUZM); Finland: 10 ♀ (CH,

DAFZ); Sweden: 2 ♀ (CH); USA: Michigan 1 ♀ (USNM), West Virginia 1 ♀ (LUZM). Holotype ♀ (not seen) in HNHM.

Distribution.—*Grahamia tatrlica* is recorded from Europe (Finland, Hungary (Erdős 1966), Sweden, Switzerland (Erdős 1966)), Canada (Nova Scotia) and the United States (Michigan, West Virginia). This species was previously not recorded from the Nearctic.

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